Determination of the Density Change of Glass by the Sink-Float Method. (III) : Density Characteristics of Rods of Glass

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Table 1 shows that the pure organic solvents have regular viscosity, while Table 2 show that 1 % aqueous solution of gelatin has "structure viscosity." From these facts, this viscosimeter is seemed to be conveniently utilized for the study on the fluid system exhibiting structure viscosity.

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11. Determination of the Density Change of Glass by the Sink-Float Method. (III)

Density Characteristics of Rods of Glass

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In the previous paper (*this Bull.* **20,** 54, 1950) the authors have pointed out that the density of rod of soda-lime glass drawn and cooled in air decreased with the decreasing diameter and the density difference between the rod of a definite diameter and that of the glass annealed by a definite schedule was constant. It was believed that the result should be extended to some kinds of glasses having different thermal charactersitics. To this purpose, the density-diameter relations of several glasses were determined by the sink-float method (*ibid.* **19,** 52, 1949).

The results obtained are summerized in Table 1.

Table 1. Percentage Difference Between Densities of the Annealed Sample, d_A, and of the Rod as Drawn, d_R, and Thermal Expansion Characteristics of Glass.

Type of glass	Example of density value (annealed) d_A (g/cm³)	$(d_A-d_R)/d_A\times100$ (%) Diameter of rods as drawn (mm)						Deformation point	Transf. point	Cubical coefficient of thermal expansion	
		0.5	1	2	4	6	8	D.P. (°C)	T.P. (°C)	Below T.P.	Above T.P.
1. Soda-lime glass	2.4984[1]	0.54	0.47	0.40	0.35	0.32	0.30	610	530	2.7×10^{-5}/°C	$12.8\ 10^{-5}$/°C
2. Borosilicate glass	2.5167[4]	0.95	0.86	0.76	0.64	0.58	0.53	618	550	2.6 〃	15.3 〃
3. Lead-(stem) glass	3.0804[2]	0.42	0.37	0.32	0.28	0.27	0.26	499	440	2.8 〃	9.0 〃
4. Boric-oxide glass	1.8564[3]	—	—	3.09	2.74	2.59	—	298	250	5.0 〃	45.5 〃
5. Quartz glass	(2.203)[5]	—	—	−0.12	−0.06	0[5]	—	—	—	—	—

1) 2) and 3) were annealed at the constant rate of 0.5°C/min below 600°, 480° and 290°C respectively.

4) Density of the fine annealed optical glass (B. K. 7).

5) The density of the air cooled rod of quartz glass drawn decreases with the increasing diameter, which can be explained by assuming the negative coefficient of expansion in the solidifying range (c.f. Salmang and Stoesser; *Glastech. Ber.* 8, 463, 1930).

The figures in the table indicate that the percentage difference $(d_A-d_R)/d_A \times 100$ increase nearly linearly with the decreasing diameter, as disclosed by Duff (*J. Amer. Ceram. Soc.* **30** (1) 12, 1947) with a certain flint and an amber glass, as long as the latter lies in a narrow range. However, more exactly, the gradient of the curves representing the diameter–density relations increases more and more rapidly with the decreasing diameter. Although, the density differences between the annealed and the rapidly cooled samples can be explained, at least qualititatively, by the differences between the coefficients of thermal expansion above and below the transformation point.

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12. On the Study of the Electrolysis by the Schlieren Method

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By the schlieren method, some optical heterogeneities were observed photographically in aqueous solutions during electrolysis. Electrolytes used were as follows: $CuSO_4$, $ZnSO_4$, $CuCl_2$, NH_4Cl, KCl, NaCl, HCl, and NaOH. Those concentrations were held at about 0.1 N respectively. Brass plates, Pt plates, Pt wires or Hg were used as electrodes. Potential differences applied between those electrodes wre 2~10 volts and the electrodes were held 2 cm apart. The thickcess of the solution was 0.5 cm. A vertical slit was set in front of the mercury lamp, and a knife edge in front of the camera lens.

During electrolysis of $CuSO_4$ solution with brass electrodes, several striae appeared ascending from the negative electrodes, and descending from the positive one. It was considered that the ascending striae were caused by evolution of small hydrogen bubbles and the descending striae by dissolution of the positive electrode.

In the case of Pt electrodes, no downward striae were observed, but upward ones only appeared at the negative electrode. When Hg was used as negative electrode and Pt as the positive one, no striae were recognized at both electrodes, but large bubbles appeared on the Hg surface. This different types of gas evolution from the negative electrodes (Pt or Hg), were ascribed to the difference of the catalytic activity of the electrode metals.

After about 8 minutes starting electrolysis, between two electrodes, one or several streight lines appeared horizontally or diagonally. These lines show that some heterogeneous distribution of solute ions is occurring in the solution during the electrolysis. The situations of their lines are largely affected by the geometrical conditions of the electrodes. All experiments were carried out without disturbance of the solution by stirring.